Envisioning a future of New Zealand climate science - Summary of discussions

1. Introduction

This paper summarises the discussions had during a workshop of climate scientists held in Wellington on 21-22 February 2024, convened by the Deep South Challenge. With the end of the Deep South Challenge and several other large climate science research projects, and on the back of long-term atrophying of core research funding, the purpose of the workshop was to bring climate scientists together to discuss the future of the climate science research sector. This paper covers the international and domestic perspectives discussed, and suggestions for the climate science research sector going forward.

The group represented a small subsection of New Zealand's wider climate research enterprise, and research areas represented were global climate models, oceans in the climate system, Antarctica and glaciers in the climate system, clouds, aerosols and climate feedbacks, regional modelling for application scales, and large ensemble modelling and attribution. Perspectives noted in this summary are not necessarily held by all members of the group.

A one-page advocacy document was written after this meeting, circulated to participants, and can be found here.

2. International perspectives

Climate science, by definition, is a global endeavour. And as international collaborations are highly beneficial to New Zealand scientists, New Zealand climate scientists are also critical to the global climate science community. This section explores some of the strengths of New Zealand climate science in the international arena, and some areas where we can improve.

Some of the key messages to come out of the discussions were:

I. New Zealand offers a critical geographic focus to the global climate science community

- New Zealand can run and facilitate observations from hard-to-reach, and climatically important, areas (e.g. our contribution to the Argo programme, voyages into the Southern Ocean, Antarctic science and the Lauder station). This geographic diversity is important to the global climate science community and global climate science to validate process studies and model development, and long-term monitoring programmes are critical to the value of these datasets.
- Alongside geographically important observations, New Zealand science and scientists can focus modelling efforts on critical processes in the Southern Hemisphere, in the midlatitudes, Southern Ocean and Antarctica, which are of importance to global modelling efforts.

II. New Zealand as a leader

- Though the climate science community in New Zealand is "spread thin" there are areas of critical mass contributing to leading-edge global (and local) science, e.g. attribution science, and we have a strong international reputation for excellent climate science across many disciplines.

- We have a short decision-chain from research to government, making our science-policy pathway more efficient than most countries.
- We play an important role in supporting Pacific nations through modelling and observational science programmes.

III. International collaborations benefit New Zealand science

- Through resource sharing; such as research vessels, computing resources, modelling support, observational technology, and data, as well as allowing access to and collaboration with other national research programmes and their science. This gives New Zealand science and scientists far greater capabilities that we could achieve on our own, and this is built on reciprocity.
- Through collaboration, we have the ability to influence international programmes, such as Argo, to support New Zealand's interests.

IV. However, there are areas where New Zealand can improve in its international collaborations

- More could be done to engage with organizations like WCRP (World Climate Research Programme) and the IPCC to improve efficiency and to seize research opportunities, which currently struggles due to poor resourcing of national coordination roles. There is also a new Centre of Excellence in Australia, *21st Century Weather(CLEX)* where collaborations could be valuable.
- There's potential for expanding collaborations beyond current partners like Australia and the UK to regions like East/South Asia, South America and the Pacific, for both science collaborations as well as providing impacts and attribution information for adaptation
- We could develop education or research training for Pacific researchers, or host emerging researchers from the US and elsewhere.

3. Domestic perspectives

The instability and reduction of climate science resourcing in New Zealand means that climate science research and capability in New Zealand is under threat. This section explores the domestic situation in New Zealand; strengths, challenges, observations and suggestions for improvement.

I. Maintaining the integrity of climate information for New Zealand

- In order to be able to inform New Zealand's climate response, we need experts in New Zealand. Though NZ is a small research community, there is a critical role for climate scientists in NZ to correctly interpret and analyse international research for the benefit of New Zealand. Without domestic climate science, we will not be able to understand international climate change research for New Zealand, and non-standard information and data products will be increasingly used. This requires New Zealand scientists to be active and contributing to the international modelling community.

II. Workforce

- Due to our size, climate science in New Zealand is vulnerable to losses of key researchers. And due to the instability of research funding, capability and capacity loss is of widespread concern. There were strong concerns raised that losing capacity and capability in vital areas would have significant consequences to the ability to respond to any future requests of climate expertise, and be incredible difficult to rebuild in response to any domestic need for the science. "The loss of one or two people is the loss of a field."

- There was a general sense that the community could grow a bit, but not, say, double in size. There is space to grow especially for society-facing research; however, this cannot happen without consistent, inflation-adjusted and secure funding.
- Researchers here are expected to be flexible in what they will work on (e.g. one researcher on both sea ice in Antarctica and wildfires in New Zealand), in order to stay employed, and at the same time are producing internationally-recognised science .
- There are not enough postdoctoral positions, or pathways into permanent jobs for early-career researchers.
- There should be ways for people to be recognised in NZ for model developments, given the time and effort that it takes to do so.
- Regarding educational pathways: Most graduate students come from overseas; should New Zealand build stronger education pathways for domestic students?

III. Collaborations

- A lack of funded time was seen to hinder collaboration efforts, as the “weak interactions” that are not tagged to a research project are not resourced.
- It's essential to ensure that all collected data is easily shared among collaborators; there are still data access and data sharing barriers in and across New Zealand climate science.
- Collaborative, cross-institutional science should be better promoted and celebrated.
- Though the Antarctic Science Platform has a latitudinal limit of 60S, there is space to think about how targeted research could link ASP science into impacts for New Zealand.

IV. Research prioritisation

- Lessons could be learnt from Australia, Norway and Sweden in terms of strategic prioritisation of research foci rather than spreading the climate science workforce so “thin”, and strategic partnerships could be better cultivated with Australian counterparts.
- There is space for research to better meet stakeholder needs and focus more on demand-lead rather than science-lead research. There are known unmet needs, with stakeholders ready to go overseas for data or create their own “data” to make decisions, if data or analysis are not available. (See section VII, below, for discussions on this.)
- However, there is not enough opportunity in the current system for basic research. CRIs, if kept in their current form, should refocus on their missions - relating to the long-term, bedrock, fundamental science.
- Baseline observational science is critical to tell us what is happening in New Zealand, and the surrounding oceans, and to validate and improve models – adequate, stable funding is required.
- Stakeholders are increasingly asking for information on extremes, climate disruptions and the effects of these on “downstream” socio-economic systems (e.g. energy and water resources).
- Climate science research is currently predominantly surviving through “feast and famine”, lumpy funding. Any improvement to the system, including both funding structure and research prioritisation, needs to offer a more sustainable solution. Climate science, and all the benefits it brings for New Zealand, cannot be sustained through a research funding system that neglects long-term research priorities in order to respond to oft-changing, albeit potentially innovative, research directions.
- Resourcing should be distributed with a view of what is best for New Zealand, rather than best for a particular institution. Decisions on research prioritisation and funding need to be more transparent.

V. Connections with policy

- New Zealand has a short pathway to policy-makers, and some relationships are well-established; however, more could be done to resource relationship and trust building between key people in the science and policy spheres. A key challenge to this is the rapid turnover of government staff.
- Government departments need to improve their internal communications to align their respective science priorities.
- There is a need to scope the climate science research landscape and communicate this to science policy staff. Funding for long-term studies is possible out of government departments that are not MBIE (e.g. Health research at Otago).
- Common misunderstandings of policy staff with regards to climate science capability and capacity include:
    - That climate science is immediately relevant to adaptation or mitigation (without further analysis or bespoke application): the applicability of research to adaptation and mitigation actions may be overestimated.
    - That climate model output can be robustly produced through discretely commissioned projects: climate models need development before producing and evaluating projections. The lack of long-term stable funding and reliance on project-based funding means that back-ground model development will suffer or be dropped entirely, and there will be increased pressure for commercialisation.
    - The infrastructure support that is required to maintain long-term observational records: station data, the HPC and ship infrastructure require ongoing, stable resourcing in order to continue to make and store these critical observational time series. These records are hard to establish, and are critical aspect of New Zealand's contributions to the global scientific community.
    - General misunderstandings around uncertainty and complexity in climate projections.
    - Stability of the research sector: capacity is vulnerable to funding insecurity and is hard to rebuild when lost (e.g. the Deep South has built significant capacity that the country is at risk of losing). There is a strong reliance on postgraduate students to get work done.
    - The amount of time spent writing proposals (as opposed to doing research) is inefficient. Competition is valuable, as it generally improves research and research proposals, but with such limited funding, the current level of competition, low success rate of proposals and the time involved in proposal-writing is out of balance.
    - The disciplinary diversity is underestimated, and political homogeneity within the community is overestimated.
    - There are large disconnections between what the science is saying and local government planning, though this is also to do with a messy and unstable regulatory space.
    - Government departments often think that universities are funded by government, so researchers should work for them. This is not how the funding system works.

VI. Balancing public good science versus science as a service

- There's a need for better understanding and differentiation between consultancy work and research, particularly within universities.
- There are also differences in consultancy work, where one is justifiably "user pays" and the other should be supported through public funds.

- There's a need to expand the science activity and provide more opportunities for translators to bridge the gap between science and private sector companies. The need for applied science cannot be met in the current research environment. There are known stakeholder needs from five years ago in the climate science space that have still not been met.
- Lack of standing capacity to fulfil customer needs results in significant overheads and pre-work requirements, indicating inefficiencies.

VII. Connecting with users (domestically and internationally)

How can we better connect with those who use our science?

- Co-develop research priorities/projects between scientists and stakeholders, including working more closely with Chief Science Advisors in government departments.
- Secondments between policy and science roles (with the right enabling environment/incentives).
- Networking opportunities with stakeholders – there are many potential users for climate science who currently are not connected to the science.
- Improve data availability - there is a need to develop platforms for direct access to data and data products.
- Better integration with international efforts and institutions; e.g. IPCC, WCRP, NCAR, CSIRO, BMRC (Bureau of Meteorology Research Centre).
- Develop better connections with media, for public education around climate science, as well as expert comments on the immediacy of climate issues (regarding adaptation and extreme events).

VIII. Research advancements that would be strategic for NZ to pursue

Climate science:

- Changes to and climate processes for extreme rainfall; e.g.
    - The sources and processes of extreme precipitation in sub-tropics and Southern Hemisphere midlatitudes
    - Processes leading to super Clausius-Clapeyron scaling
    - Changes in westerlies and atmospheric rivers
    - Precipitation patterns
    - Intensity and frequency of future extreme rainfall (currently poorly modelled)
- Changes in ocean extremes and transport; e.g.:
    - Marine heatwaves and extreme events
    - Changes in regional ocean currents
    - Southern Ocean warm bias
    - Wind-driven ocean circulation and variability
- Southern Ocean atmospheric process studies; e.g.
    - Process-based and top-down studies of the atmosphere, leading to implications for composition and climate variability, especially over the Southern Ocean (e.g. constraining aerosol-cloud interactions)
    - Missing or poorly captured sources and processes (e.g. DMS chemistry, cloud water pH)
    - Windiness over the Southern Ocean and implications for mixing, gas exchange, aerosol production

    - The role of regional models and phenomena; e.g. ENSO, storm tracks, Intertropical Convergence Zone, South Pacific Convergence Zone
- Direct impacts of sea ice change on NZ
- Physical terrain and elevation modelling to improve regional climate modelling
- Better understanding of climate projections on decadal timescales (on timescales between weather prediction and earth system modelling)

Applied climate change research, in collaboration with climate science:

- Extreme events, (e.g. flooding and coastal erosion); quantifying the impacts and consequences of these events, including the economic, hydrometeorolological, biophysicial, societal and ecological consequences, with appropriate multi-disciplinary teams.
- The intersection of generative AI with climate modelling, particularly to reduce the computational costs of downscaling.
- Climate science that offers data and products for companies disclosing under TCFD; e.g. insurance companies.
- Connecting with the space programmes; e.g. *Tāwhaki National Aerospace Centre*

4. Looking forward

There was a general appetite for ongoing conversations within the community about a way forward. Some suggestions included:

- Having working groups with the broader climate change research community (requiring resource and leadership), including specific disciplinary working groups.
- Exploring the idea of a “WCRP for NZ”, which would set up a group with the ability to make recommendations to government with authority .
- In order to advocate for climate science, explore putting a dollar value on the value that climate science provides (e.g. how MBIE assess research programmes), noting also that it is important to tell the story of how the science feeds through to impact society.

Examples of national endeavours conducted overseas that New Zealand could explore:

- A three-yearly IPCC-esque climate assessment for NZ, supplemented with annual interim reports, including analyses of research needs
- A national climate science strategy, with input from the climate science community
- A national climate services for data and data products
- A “NZ Inc” climate research platform

A representative of the Meteorological Society has committed to seeing if the Society would be interested in continuing these conversations, with the end of the Deep South Challenge.